S/N

INSTRUCTIONS

for the use of

SINGLE ELEMENT PORTABLE WATTMETER

WESTON MODEL 432

WESTON INSTRUMENTS, INC.

NEWARK, N. J., U. S. A.

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INSTRUCTIONS FOR USING WESTON WATTMETER, MODEL 432

This instrument is a magnetically shielded electrodynamometer wattmeter; its indications are based on the absolute volt and ampere. It was standardized at the Weston Laboratory at an ambient temperature of 25C (77F) using direct current and voltage, taking the mean value corresponding to two directions of current flow through the instrument.

Rated Accuracy: 0.5% of full scale value for instruments made for the standard frequency coverage of d-c and 25-125 cycles and when compensated for d-c and 25-1000 cycles. Accuracy is reduced for instruments compensated for higher frequencies usually being 1% of full scale value for d-c and 25-2500 cycle coverage.

Position: The instruments are adjusted for use in the horizontal position and must be used in the position for best accuracy. Instruments supplied on special order adjusted for use in the vertical position may have an additional 0.5% of full scale value error and must be used in the vertical position to obtain the best accuracy.

External Temperature Influence: Less than 0.4% of full scale value from 15C to 35C (59F to 95F).

Frequency Range: Unless the dial is marked otherwise, the frequency range is direct current and 25 to 125 cycles. When the instrument is compensated for higher frequencies, the frequency range is marked on the dial.

Frequency Influence: Negligible from 60 cycles to direct current or to 125 cycles per second at any power factor from 0.5 to 1.0 inclusive. Below 0.5 power factor the frequency influence is less than 0.3% of full scale value. Instruments rated d-c and 25-125 cycles can also be used at higher frequencies with slightly larger frequency errors. For example, the frequency influence up

to 500 cycles is less than 0.5% of full scale value for any power factor from 0.5 to 1.0 inclusive.

Power Factor Influence: Negligible from 1.0 power factor to any other power factor at 60 cycles.

Voltage Influence: Negligible from 0 to maximum voltage for general use types.

External Field Influence: Maximum effect less than 1% of full scale in a field of 5 oersteds.

Zero Corrector: A zero corrector, located at the center of the nameplate, is provided so that the pointer can be set to zero if it should happen to be off zero when no voltage and current are applied.

Binding Posts: Two large binding posts are supplied for current connection and two or more smaller insulated binding posts are supplied for potential connections. The potential binding posts are marked with the rated value of the voltage range they represent. The post common to both ranges is marked "±". This mark also indicates that this binding post is connected directly to the moving coil.

Polarity: The "±" mark on both current and potential binding posts signifies that the instantaneous currents entering into or passing out from these binding posts have the same direction for an up-scale indication of the pointer.

Ranges: The instrument is normally supplied with two self-contained voltage ranges and one or two current ranges. Potential ranges are selected by connecting to the binding posts marked with the range desired. Double current range instruments are supplied with a switch marked "High" and "Low" signifying high and low current ranges.

The scale ranges are usually based on the product of rated volts and rated amperes for the general use instrument. These instruments are normally used where the power factor of the load is above 0.5. The scale range of low power factor instruments is usually equal to the product of maximum volts times maximum amperes times 0.2. These instruments can be used at any power factor but are usually used where the load power factor is quite low.

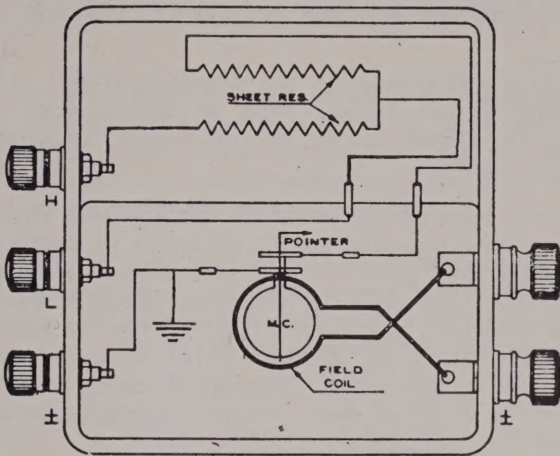
Double-voltage, single-current range instruments are supplied with two scales, one for each voltage range. Double-voltage and double-current range instruments are supplied with three scales. The low-scale range is used when connections are made to the low voltage range with the current range switch set to "Low". The middle-scale range is used when connections are made to the high voltage range with the current range switch set to "Low" and also when connections are made to the low voltage range with the switch set to "High". The high-scale range is used when the connections are made to the high voltage range with the switch set to "High". This is shown in the tabular form below.

Voltage Range		Current Range		Scale Range		
Low	High	Low	High	Low	Middle	High
X		Single range		X		
	X	Single range				X
X		X		X		
X			X		X	
	X	X			X	
	X		X			X

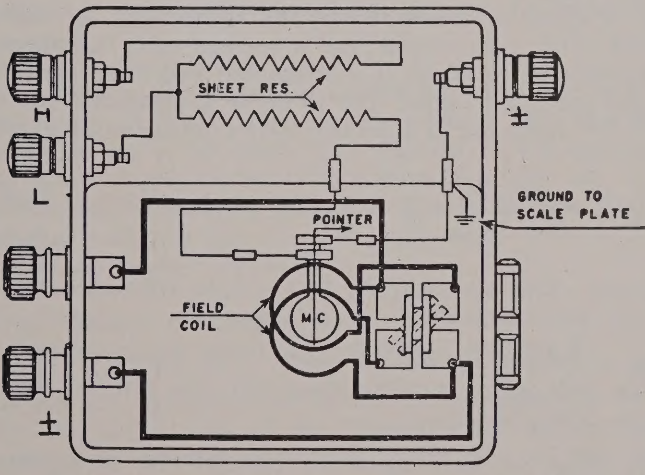
Extension of Ranges: The current range can be extended by means of a current transformer. A Model 461 type 2 or type 5 current transformer is recommended for use with a wattmeter having a current rating of 5 amperes. For other wattmeter current ratings, a special transformer may be used for range extension.

The potential ranges can be extended by means of a potential transformer such as the Model 311 used with an instrument having a voltage range within the span of 100 to 150 volts. For voltages less than 750 volts a multiplier may be used, but for higher voltages it is safer to use both current and potential transformer since then only a low voltage is applied to the instrument.

Maximum Rating: The scale is marked with the maximum continuous voltage and current ratings. These values can be exceeded only for a very short period of time provided the windings are allowed to cool again before repeating the overload.



Internal Connections of Single-Current Range Wattmeter



Internal Connections of Double-Current Range Wattmeter

Figure 1.

Internal Connections of Model 432 Wattmeter.

USE OF MODEL 432 WATTMETER

The instrument should be connected in circuit as shown in the diagrams found further back in this booklet, beginning with page 10, which covers all the circuit conditions usually met with in practice.

In general, connect the field or current coil in series with the load and the potential circuit across or in parallel with the load as shown in figure 3, page 10. Always connect the ± binding post of the potential circuit to the side of the circuit under test in which the current coil of the wattmeter is connected. This should be done so as to have the current and potential coils at the same potential to eliminate the electrostatic attraction between them, which might otherwise introduce an error in the indications.

Use of Multiplier: If a multiplier is used to extend the voltage range, it must be connected to the instrument for which it is adjusted. One post on the box is marked with the range of the instrument post to which it is connected and the other is marked with the extended range. For example a wattmeter has a range of 150/75 volts and is supplied with a multiplier for 300 volts.

The post marked $\overset{1}{\underset{\mathrm{V}}{150}}$ is connected to the 150 volt post of the wattmeter. The post marked $\overset{2}{\underset{\mathrm{V}}{300}}$ is then connected to a circuit having a voltage up to 300 volts. The number "2" indicates that the watt range corresponding with the 150 volt scale range must be multiplied by 2.

Care must be taken never to connect the multiplier to the ± binding post of the instrument, as such a connection will put a high voltage between the current and potential coils, which may cause electrostatic attraction between them, intro-

ducing errors and placing an unnecessary stress upon the insulation.

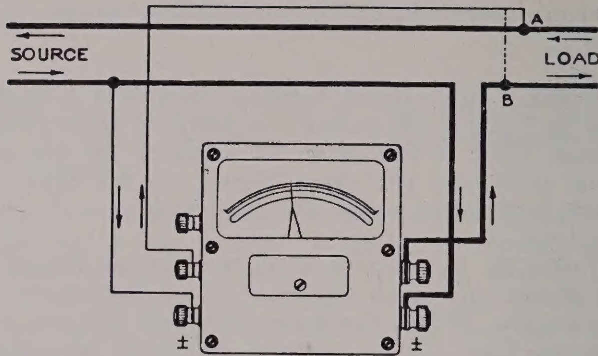
Use of Y-Box. An external Y-Box is used with a single phase wattmeter to measure the power in a balanced three phase, three wire system. The Y-Box must be adjusted for use with the instrument used and the three phases of the load must be balanced in both phase angle and magnitude.

The Y-Box in its simplest form is a center tapped resistor with the resistance in each leg equal to the instrument potential circuit resistance. When the instrument and box are connected as shown on Page 20, an artificial neutral is formed and the phase voltage of the system is impressed upon the instrument. The total three phase power will then be three times the instrument indication. Three phase lines having a phase voltage greater than the instrument rating use a Y-Box in which the resistance in each leg is adjusted to a multiple of the instrument resistance with a corresponding increase in scale multiplying constant.

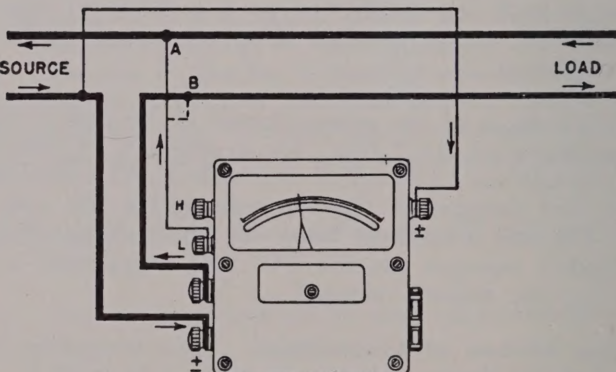
The line voltage of the system should be no higher than the maximum rating of the Y-Box. For example, a 75/150 volt instrument should use a 150 volt Y-Box with the 75 volt instrument range for line voltages of 100-170 volts and a 300 volt Y-Box with the 150 volt instrument range for line voltages of 200-340 volts. Higher voltages use the 150 volt range with a Y-Box adjusted for the higher voltage.

Alternative Method of Connections. The wattmeter may be connected to the circuit as shown in figure 2 on page 8.

In this method the potential circuit of the wattmeter is connected on the source side of the current coil and the instrument includes in its indication the power lost in the circuit between the potential circuit connection and the load; that is, the loss in switches, fuses, or other auxiliary apparatus, as well as in the current or field coils of the instrument.



Connections for Single-Current Range Wattmeter



Connections for Double-Current Wattmeter

Figure 2.

Connections for Measuring D.C. and Single Phase A.C. Power; Instrument Connected to Include in the Indication Its Current Circuit Losses.

This method of connection possesses several disadvantages. When current transformers are used it is difficult and often impracticable to allow for the losses, and in all cases the losses vary with the current and with changes in temperature, so that the correction to be applied very often cannot be accurately determined.

Where the loss between the wattmeter connection and the load is that of the wattmeter current circuit, the loss is so small that it may be neglected except in the case of low range wattmeters.

Should any circumstances arise, necessitating the use of this method of connection, the wattmeter indication may be corrected by changing the potential connection from A to B in figure 2, page 8, which measures the wattmeter loss, and then subtract this from the load reading, as described below.

METHOD OF CORRECTING FOR WATTMETER AND TRANSFORMER LOSSES

The loss in the wattmeter potential circuit at 115 volts is approximately 1.2 watts and in the current circuit at normal current capacity is approximately 0.65.

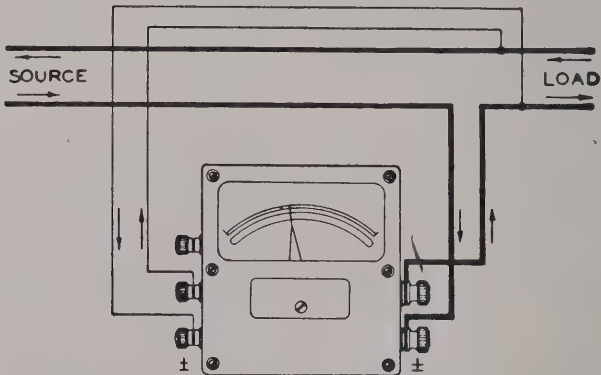
These losses are usually so small in comparison to the load being tested that they may be neglected.

In the measurement of small loads using connections shown in fig. 3 to 8 inclusive, where the wattmeter or transformer losses form a considerable part of the indicated load, the indication may be corrected for both wattmeter and transformer loss by opening the load circuit on the load side of the wattmeter or transformer connections. The resulting indication represents the sum of all losses. This should be subtracted from the total load indication and the remainder multiplied by the proper transformer and wattmeter ratios to obtain the true load.

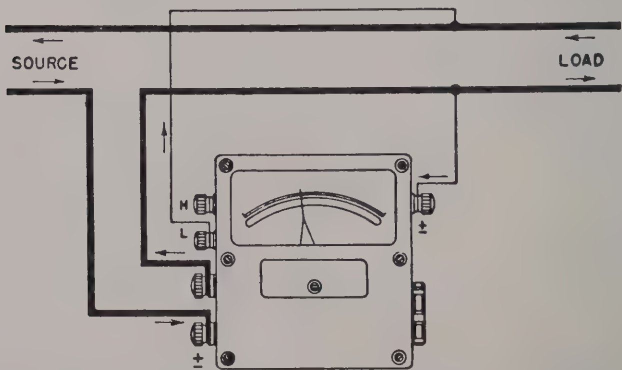
When the potential circuit is connected on the source side of the wattmeter current circuit as shown in fig. 2, page 8, either with or without transformers, and the losses in the current circuit including losses in transformers, fuses, switches, etc., form a measurable part of the indicated load, the indications can be

corrected by changing the potential connection from A to B in fig. 2. The resulting indication represents the losses which should be subtracted from the load indication and the remainder may then be multiplied by the wattmeter constant and by the ratios or transformer, if any, to obtain the true load.

DIAGRAMS OF CONNECTIONS FOR USING WESTON MODEL 432 WATTMETER



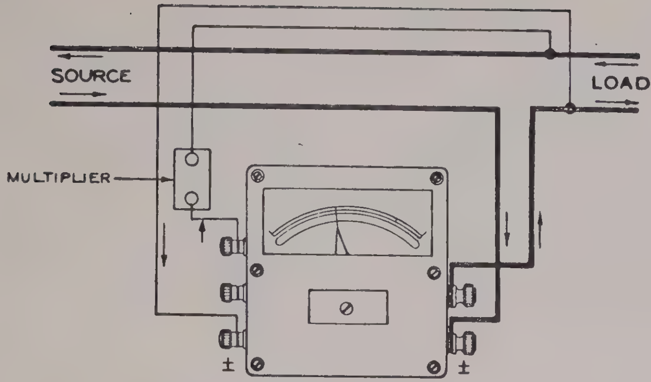
Connections for Single-Current Range Wattmeter



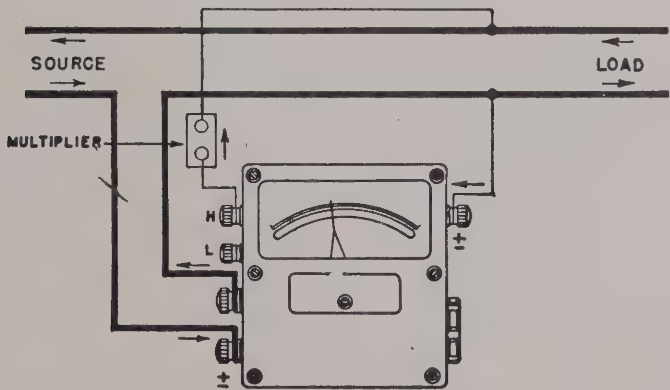
Connections for Double-Current Range Wattmeter

Figure 3.

Connections for Measuring D.C. and Single Phase A.C. Power; Instrument Connected Directly to Load.



Connections for Single-Current Range Wattmeter

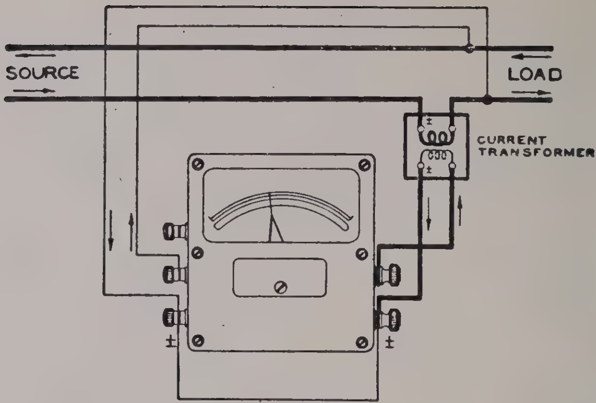


Connections for Double-Current Range Wattmeter

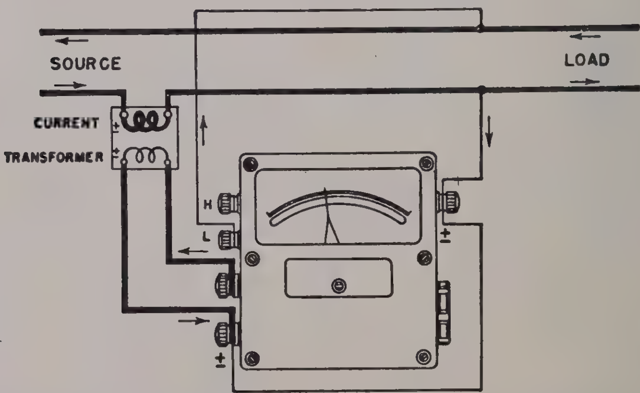
Figure 4.

Connections for Measuring D.C. and Single Phase A.C. Power: Instrument Connected Through a Multiplier.

Note: See "Use of Multiplier", Page 6.



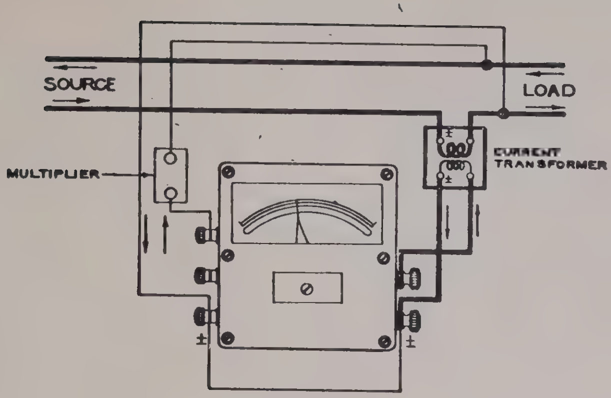
Connections for Single-Current Range Wattmeter



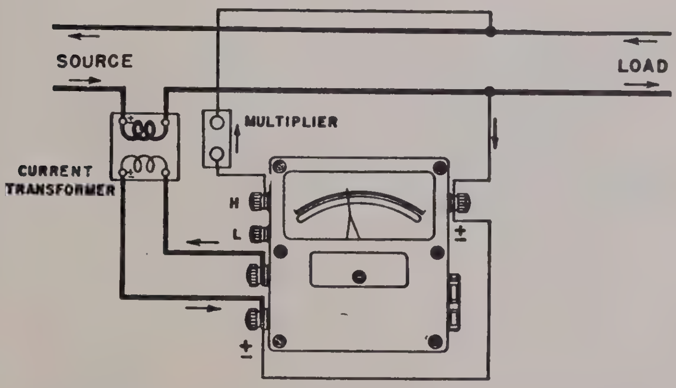
Connections for Double-Current Range Wattmeter

Figure 5.

Connections for Measuring Single Phase A.C. Power; Instrument Connected to the Load Through a Current Transformer.



Connections for Single-Current Range Wattmeter

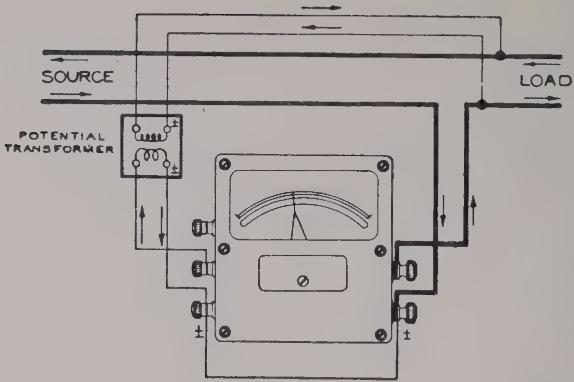


Connections for Double-Current Range Wattmeter

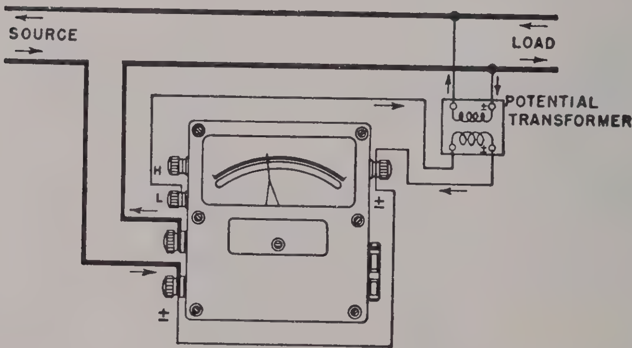
Figure 6.

Connections for Measuring Single Phase A.C. Power; Instrument Connected to the Load Through a Current Transformer and a Multiplier.

Note: See "Use of Multiplier", Page 6.



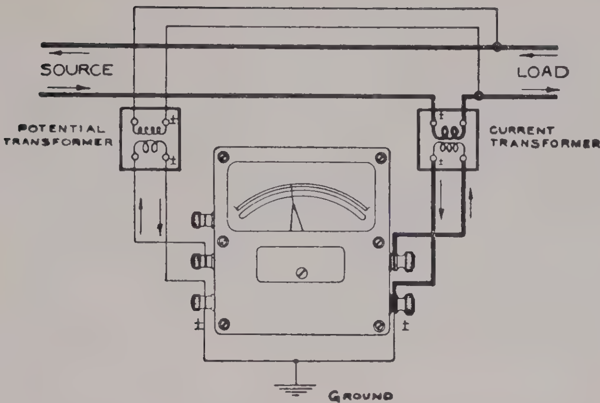
Connections for Single-Current Range Wattmeter



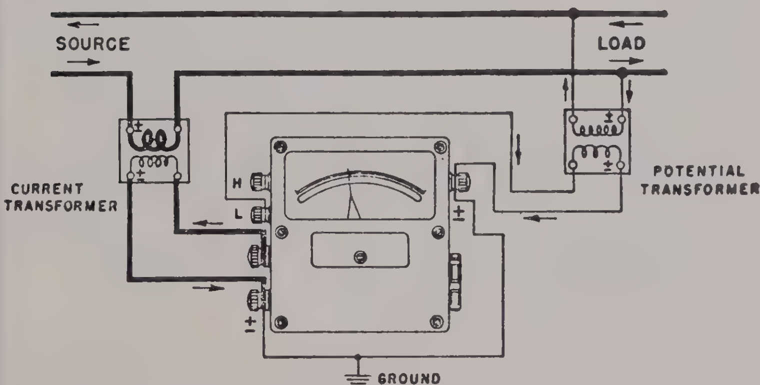
Connections for Double-Current Range Wattmeter

Figure 7.

Connections for Measuring Single Phase A.C. Power; Instrument Connected to the Load Through a Potential Transformer.



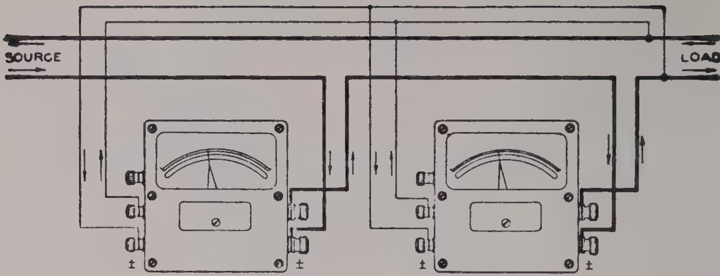
Connections for Single-Current Range Wattmeter



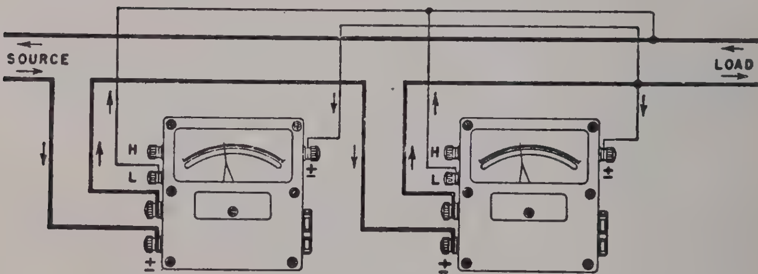
Connections for Double-Current Range Wattmeter

Figure 8.

Connections for Measuring Single Phase A.C. Power; Instrument Connected to the Load Through Current and Potential Transformers.



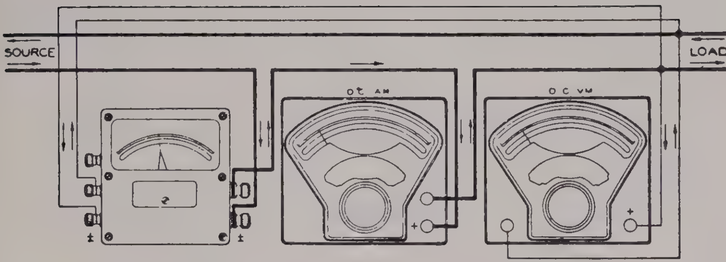
Connections for Single-Current Range Wattmeter



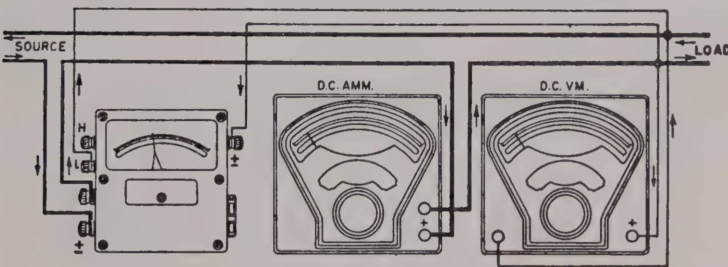
Connections for Double-Current Range Wattmeter

Figure 9.

Connection for Comparing Two Wattmeters, Using D.C. or A.C. Source; Instruments Connected Directly to the Load.



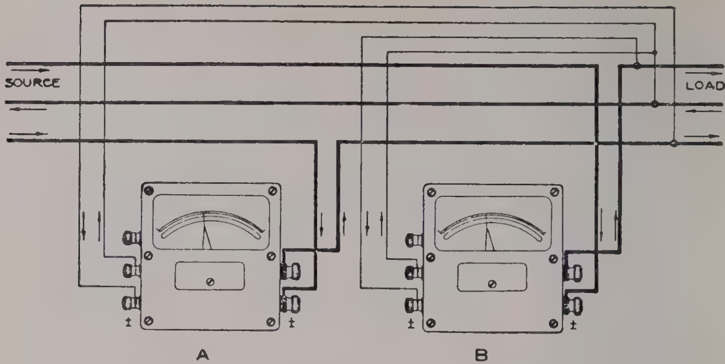
Connections for Single-Current Range Wattmeter



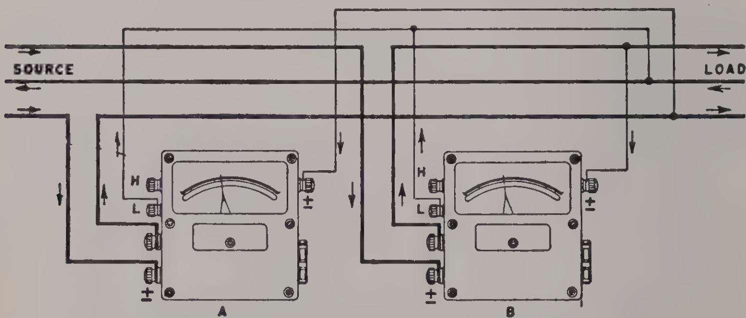
Connections for Double-Current Range Wattmeter

Figure 10.

Connections for Checking a Wattmeter with Ammeter and Voltmeter Using a D.C. Source.



Connections for Single-Current Range Wattmeter



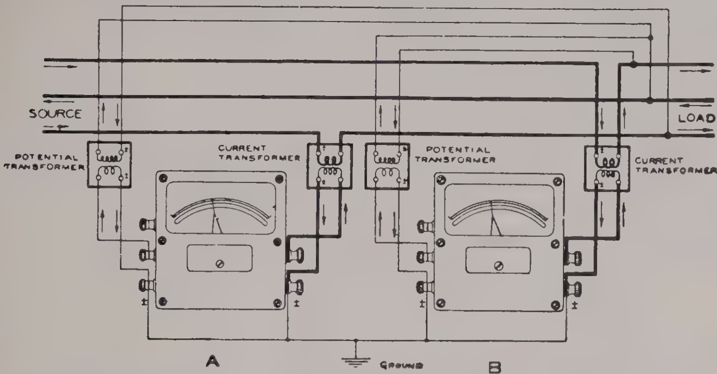
Connections for Double-Current Range Wattmeter

Figure 11.

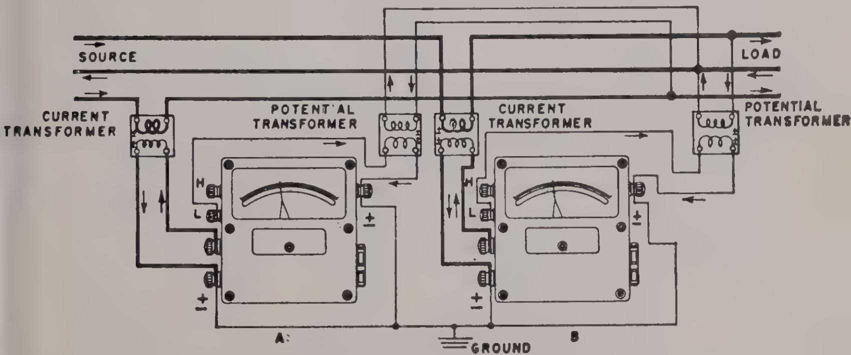
Connections for Measuring Power in D.C. Single, Two and Three Phase A.C. Three-Wire Circuits: Instruments Connected Directly to the Load.

NOTE: For Three Phase Circuits, if both instruments deflect toward the top of the scale, when connected as shown, the true power is the sum of their indications. If one instrument deflects negatively, which will be the case when the power factor

is below 50 per cent., reverse the current leads and subtract the indication from that of the other instrument to obtain the true power. If only one wattmeter is available connect it successively as A and B in cut and proceed as directed above. Arrows indicate directions of current from Two and Three Phase Circuits but not for D.C. or Single Phase Circuits.



Connections for Single-Current Range Wattmeter

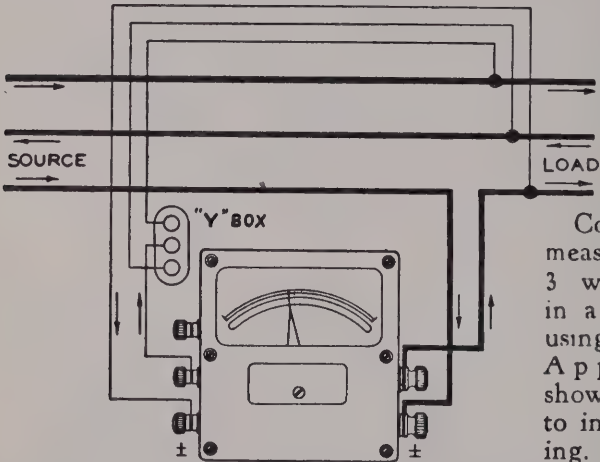


Connections for Double-Current Range Wattmeter

Figure 12.

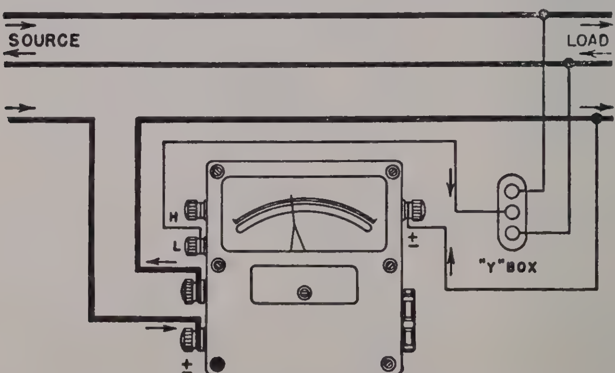
Connections for Measuring Power in Single, Two and Three Phase, Three-Wire A.C. Circuits; Instruments Connected to the Load Through Current and Potential Transformers.

NOTE: For Three Phase Circuits, if both instruments, deflect toward the top of the scale, when connected as shown, the true power is the sum of their indications. If one instrument deflects negatively, which will be the case when the power factor is below 50 per cent., reverse the current leads and subtract the resulting positive indication from that of the other instrument to obtain the true power. If only one wattmeter is available connect it successively as A and B in cut and proceed as directed above. Arrows indicate directions of current for Two and Three Phase Circuits but not for Single Phase Circuits.



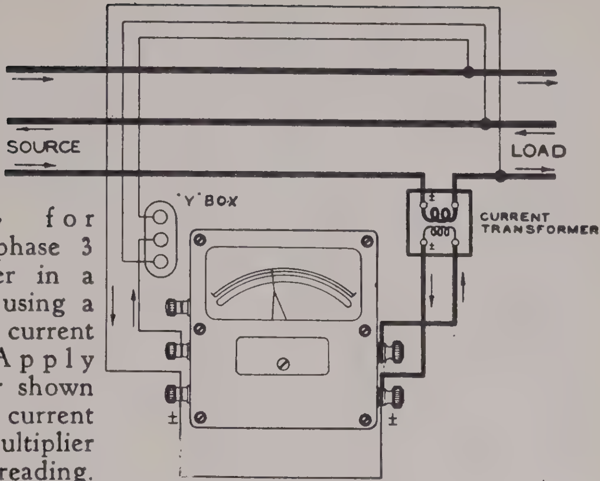
Connections for measuring 3 phase 3 wire a-c power in a balanced load using a Y-Box. Apply multiplier shown on Y-Box to instrument reading.

Connections for Single-Current Range Wattmeter



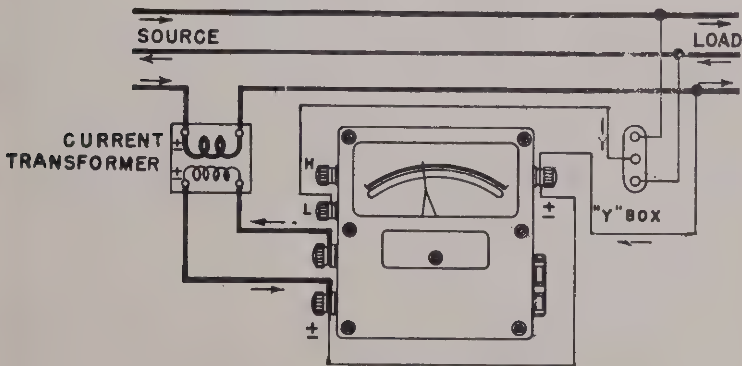
Connections for Double-Current Range Wattmeter

Figure 13.



Connections for measuring 3 phase 3 wire a-c power in a balanced load using a Y-Box and a current transformer. Apply both multiplier shown on Y-Box and current transformer multiplier to instrument reading.

Connections for Single-Current Range Wattmeter



Connections for Double-Current Range Wattmeter

Figure 14.

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